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91156



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Level 2 Biology 2022

91156 Demonstrate understanding of life processes at the cellular level

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of life processes at the cellular level.	Demonstrate in-depth understanding of life processes at the cellular level.	Demonstrate comprehensive understanding of life processes at the cellular level.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (XXXX). This area may be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement

TOTAL

12

QUESTION ONE: PHOTOSYNTHESIS

All plants require specific reactants to start the process of photosynthesis.



Source: <https://www.doc.govt.nz/nature/native-plants/>

- (a) Describe the reactants required for photosynthesis AND how they enter the plant.

Water + Carbon dioxide $\xrightarrow{\text{light}}$ Oxygen + water

Water enters the plants through osmosis, water flows from an area of high concentration in the soil to low concentration in the roots. Carbon dioxide enters through the stomata through diffusion.

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- (b) Photosynthesis takes place inside the chloroplasts. The main structures involved in photosynthesis are: the outer membrane, inner membrane, stroma, thylakoid membrane, and grana.



Adapted from: www.mcqbiology.com/2013/04/multiple-choice-questions-on-chloroplast.html

Discuss how specific reactants in the light-dependent and light-independent reactions affect the amounts of the products of photosynthesis:

In your answer:

- describe the function of TWO named structures from the chloroplast diagram
- explain how the structures of the chloroplast are built to help them carry out their function
- discuss how the structures of the chloroplast work together to carry out the process of photosynthesis.

The light dependant phase occurs in the grana and thylakoid in the chloroplast. Water is split into Hydrogen and Oxygen and the hydrogen fused with carbon dioxide entering through the stomata to create glucose. Oxygen is a waste product and is excreted. The light independant phase occurs in the ~~chloroplast~~ stroma and unlike the light dependant phase occurs without the prescence of light.

Chloroplast contain many bumps and ridges, especially in the grana and

There is more space for your answer to this question on the following pages.

thylakoid and this aims to maximise the surface area they have and that the sunlight can hit so more water can be split and use the hydrogen to produce more glucose.

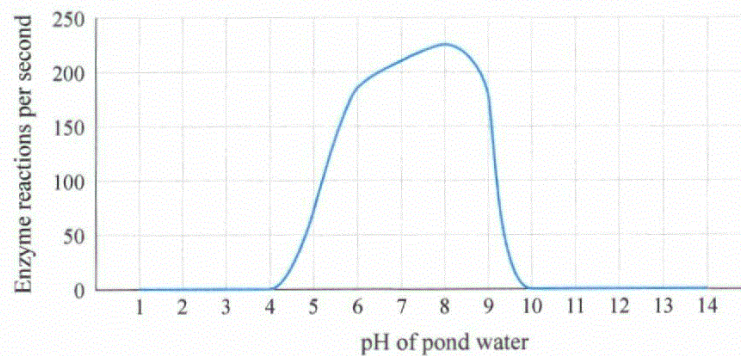
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QUESTION TWO: ENZYMES

Conditions of the water in a small pond can change throughout the day, and over a year. A change in pH can affect the rate of photosynthesis reactions. The presence of pollutants in the water can affect certain nutrients that are needed as co-factors for the enzymes involved in photosynthesis.

In an experiment to test the effect of pH on enzyme activity in *Elodea* cells, the following results were produced.

Rate of *Elodea* enzyme reactions as a result of changing pH



Adapted from: <https://pubmed.ncbi.nlm.nih.gov/20118304/>

- (a) Discuss the effects of pH and co-factors on enzyme activity in *Elodea* plants.

In your answer you should refer to the graph above and:

- describe the function of enzymes and their structure
- explain how co-factors affect enzyme activity
- discuss how and why pH affects enzyme activity in *Elodea*.

Enzymes are biological catalysts that such as proteins that provide an alternative pathway for the reaction to occur with lower activation energy and without being used up itself.

Co-factors are metal ions that accelerate enzyme activity.

Denaturing is when the 3D shape of an enzyme is permanently altered and so the substrate can no longer fit into it.

Enzymes have an ideal pH to operate at and so if the pH is above or below that ideal window, then the enzymes can potentially denature leaving the substrate unable to bind to it and the rate at which photosynthesis occurs will be slowed.

The enzyme and the substrate are a lock and key process and when the enzyme denatures at too high or too low pH's the substrate no longer fits and the reaction can not commence as effectively.

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QUESTION THREE: CELLULAR RESPIRATION

Mosquito larvae come to the surface of the water and absorb oxygen through a breathing tube. When threatened, the larvae retreat to the bottom of the pond where they can absorb dissolved oxygen from the water.

Mosquito larvae are transparent, and it is possible to observe their hearts beating under a microscope. The number of heart beats per minute can be used as a way to measure the cell respiration rate of the heart cells, and to study the factors that affect it.



Source: https://en.wikipedia.org/wiki/File:Culex_sp_larvae.png

- (a) Describe the purpose of cellular respiration.

To produce ATP or energy to allow the organism to survive.

- (b) As oxygen levels in the water decrease, respiration rate, and therefore heart rate decreases. Even when the water has NO oxygen left, the mosquito larvae's hearts could continue to beat.

	Heart beats per minute with changing dissolved oxygen concentrations in pond water				
Dissolved oxygen concentration (% saturation)	0	25	50	75	100
Number of heart beats per minute (bpm)	20	40	50	60	120

Discuss the observations above in relation to aerobic and anaerobic respiration, and their effect on the mosquito larvae's heart rates.

In your answer, refer to the data table and include:

- a description of where aerobic and anaerobic respiration take place in the cell ✓
- an explanation of BOTH respiration processes that includes the materials required for each and their products ✓
- elaborate on the possible effects on larval heart rate and type of respiration when exposed to 0% oxygen for more than a few hours. ✓

Aerobic respiration: $\text{Oxygen} + \text{glucose} \rightarrow \text{Carbon dioxide} + \text{Water} + 36\text{ATP}$

Anaerobic respiration: $\text{Glucose} \rightarrow \text{Lactic acid} + 2\text{ATP}$

Anaerobic respiration occurs in the cytoplasm and aerobic occurs in the mitochondria in the presence of oxygen.

When the larvae are exposed to no oxygen for a few hours they can no longer respire aerobically and so have to switch to anaerobic respiration which is faster than aerobic, providing more energy in a short time, but it is also less efficient and leads to a build up of lactic acid which can cause fatigue, muscle fatigue and soreness.

When more oxygen is available the larvae respire more aerobically and so their heartbeat increases with the oxygen in the blood, looking to move it around the body and feed the muscles to provide energy.

When there is less oxygen the heart pumps less often and so the oxygen gets provided less to muscles and there is less energy in the form of ATP available.

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Extra space if required.
Write the question number(s) if applicable.

QUESTION
NUMBER

91156

Standard	91156	Display ID	61717572	Total score	12
		NSN	141108841		
Q	Grade score	Annotation			
1	A4	<p>A description of the process of photosynthesis and structures involved in different parts of the process. To get to a higher grade, further detail would be needed to cover how and why these structures affect the light dependent phase or light independent phase of photosynthesis.</p> <p>Pg2</p> <p>Reactants (carbon dioxide and water) correctly identified as part of a word equation for photosynthesis. Water entering through the roots/osmosis and carbon dioxide entering through the leaves/stomata through diffusion also described.</p> <p>Pg 3</p> <p>Description of light dependent phase happens in thylakoid/grana</p> <p>Description of light independent phase happens in stroma</p>			
2	A4	<p>A description of enzyme action and effects of pH levels. To get to a higher grade, further detail on the how denaturing changes the active site and ability of substrate to bind would be needed, together with accurate use of resource information supplied.</p> <p>Pg 6</p> <p>Identifies enzymes as biological catalysts</p> <p>Description of co-factors increasing enzyme activity</p> <p>Pg 7</p> <p>States that enzymes have an optimum/ideal pH</p> <p>Describes that enzymes denature at pH levels that are too high/too low.</p>			
3	A4	<p>Descriptions of aerobic and anaerobic respiration. To get to a higher grade, explanations would be needed on how prolonged use of anaerobic respiration could cause significant harm, linked to the products of this process.</p> <p>Pg 10</p> <p>Gives purpose of cellular respiration as producing ATP/energy</p> <p>Pg11</p> <p>Describes aerobic respiration with equation</p> <p>Describes anaerobic respiration with equation</p>			

		<p>Describes location of both aerobic respiration (mitochondria) and anaerobic respiration (cytoplasm)</p> <p>Trend from the data table described (when more oxygen is available, the larvae respire more aerobically so their heartbeat increases)</p>
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